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(54) **CEILING-EMBEDDED AIR CONDITIONER**

(56) **References Cited**

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U.S. PATENT DOCUMENTS

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2006/0276123 A1 12/2006 Akihiko
2009/0025414 A1* 1/2009 Koga F24F 1/0007
62/263
2010/0192611 A1* 8/2010 Yamaguchi F24F 13/14
62/291

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FOREIGN PATENT DOCUMENTS

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EP 1688678 A1 8/2006
JP 2001133032 A2 5/2001
JP 2005249328 A2 9/2005

(Continued)

(21) Appl. No.: **14/866,145**

OTHER PUBLICATIONS

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(30) **Foreign Application Priority Data**

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Sep. 30, 2014 (JP) 2014-201524

(74) *Attorney, Agent, or Firm* — Rankin, Hill & Clark LLP

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F24F 13/06 (2006.01)
F24F 13/14 (2006.01)
F24F 1/0007 (2019.01)
F24F 1/0014 (2019.01)
F24F 1/0047 (2019.01)

(57) **ABSTRACT**

A ceiling-embedded air conditioner includes: a box-shaped housing that is embedded in a ceiling of an air-conditioned room; a square decorative panel that is attached to a lower surface of the housing and covers the ceiling; main body outlets that are provided along respective four sides of a bottom surface of the housing and blow heat-exchanged air; outlets that are provided in the decorative panel in correspondence with the main body outlets; corner blowoff units that are provided in the decorative panel in correspondence with coupling portions for coupling the outlets; a blowoff path that is circumferentially provided in the decorative panel in correspondence with the outlets and the corner blowoff units; and wind direction plates that are rotatably provided along the respective sides of the decorative panel so as to cover or open the blowoff path and are longer than a long side of the outlets.

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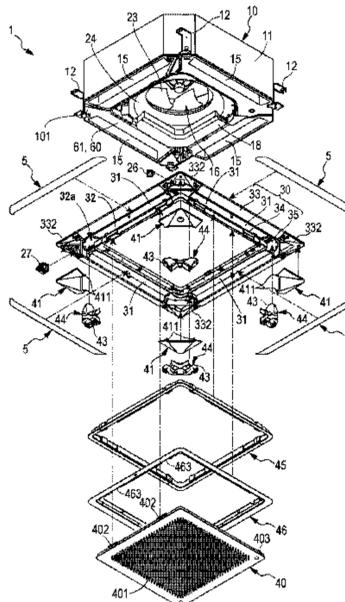
(58) **Field of Classification Search**

CPC **F24F 13/14**; **F24F 1/0007**; **F24F 1/0014**;
F24F 13/0616; **F24F 13/06**; **F24F 13/0604**

USPC **62/408**

See application file for complete search history.

18 Claims, 8 Drawing Sheets



(56)

References Cited

FOREIGN PATENT DOCUMENTS

JP	4052264	2/2008	
JP	2008-064396	3/2008	
JP	WO 2011064999 A1 *	6/2011 F24F 1/0007

* cited by examiner

FIG. 1

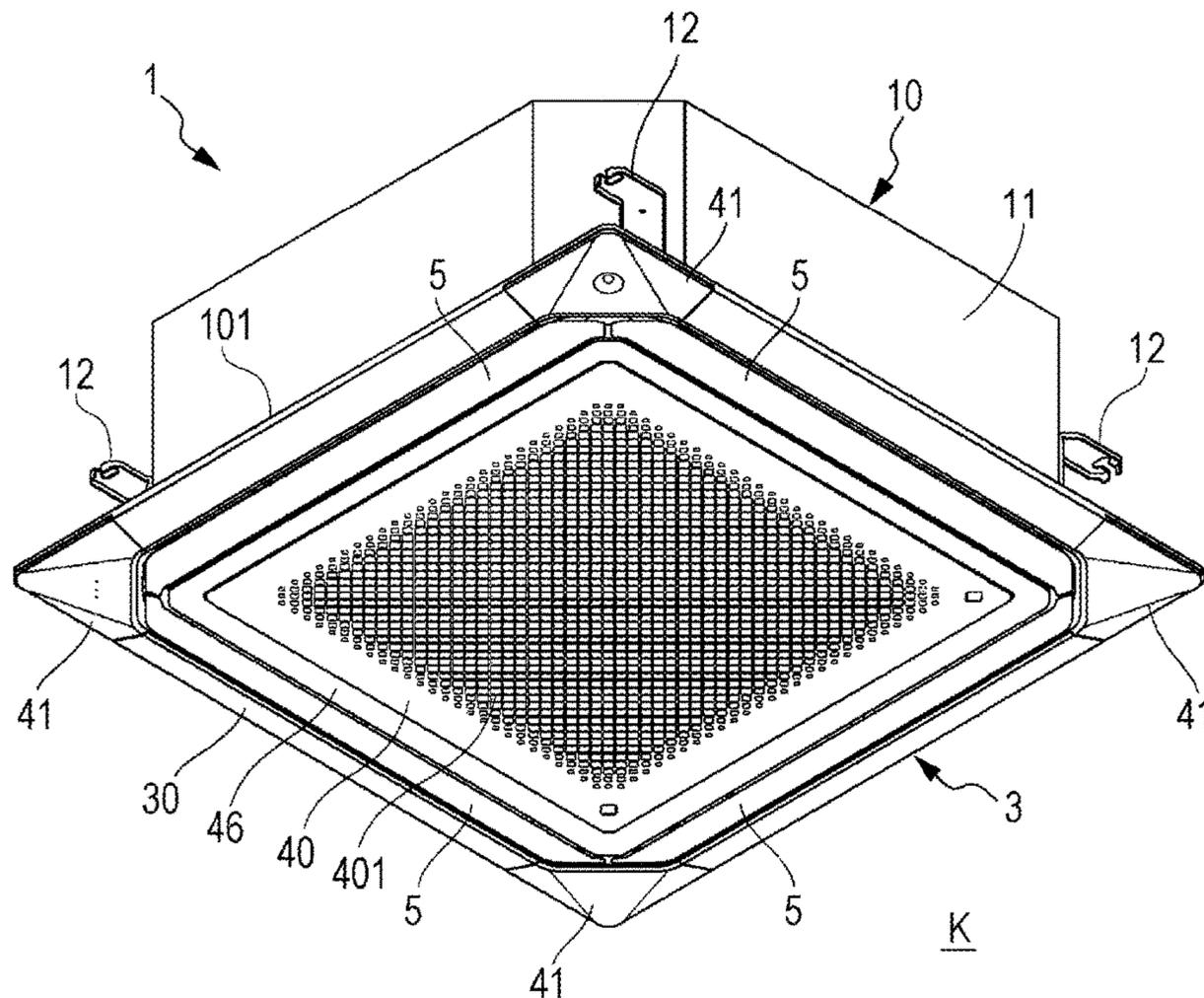


FIG. 2

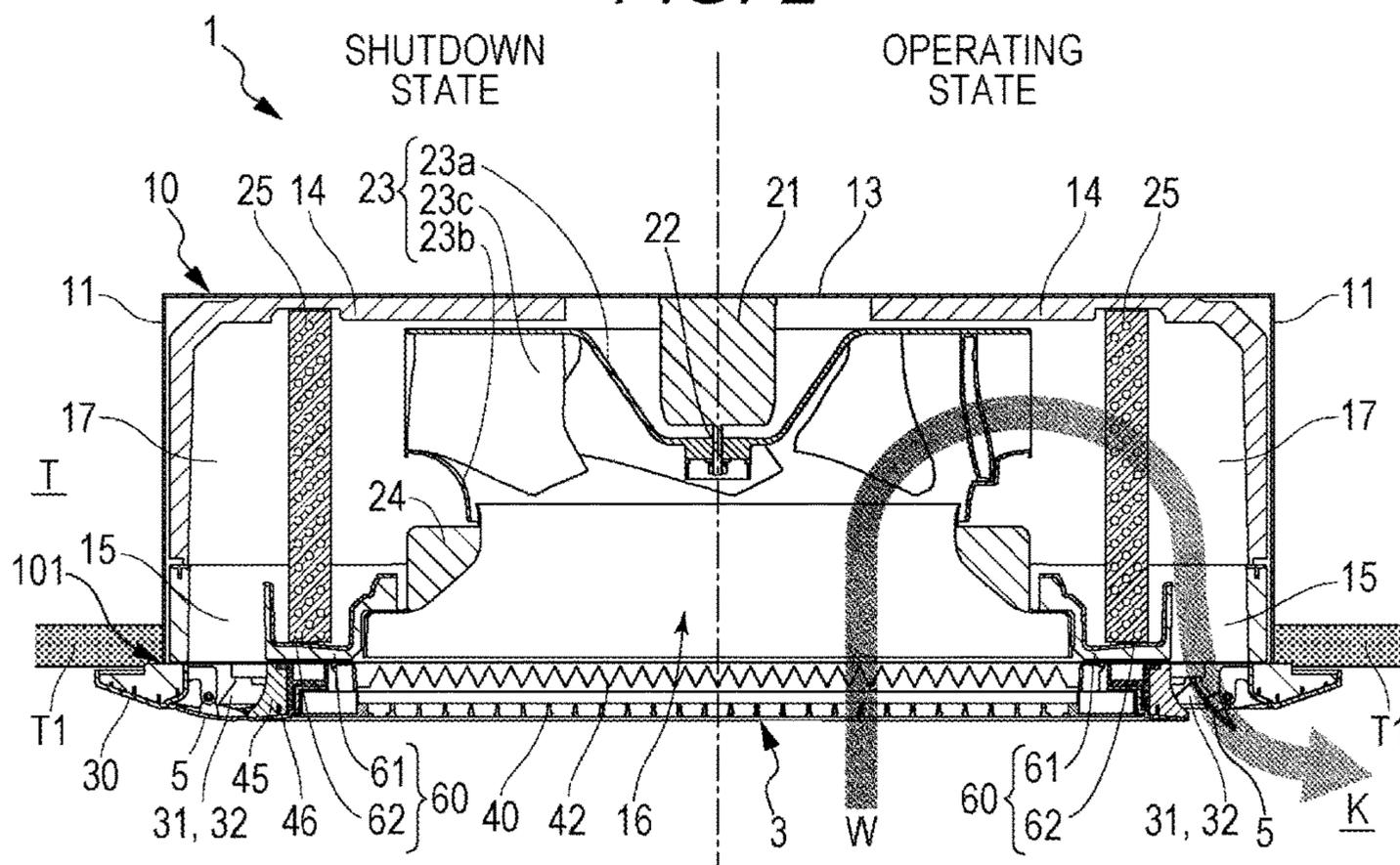


FIG. 3

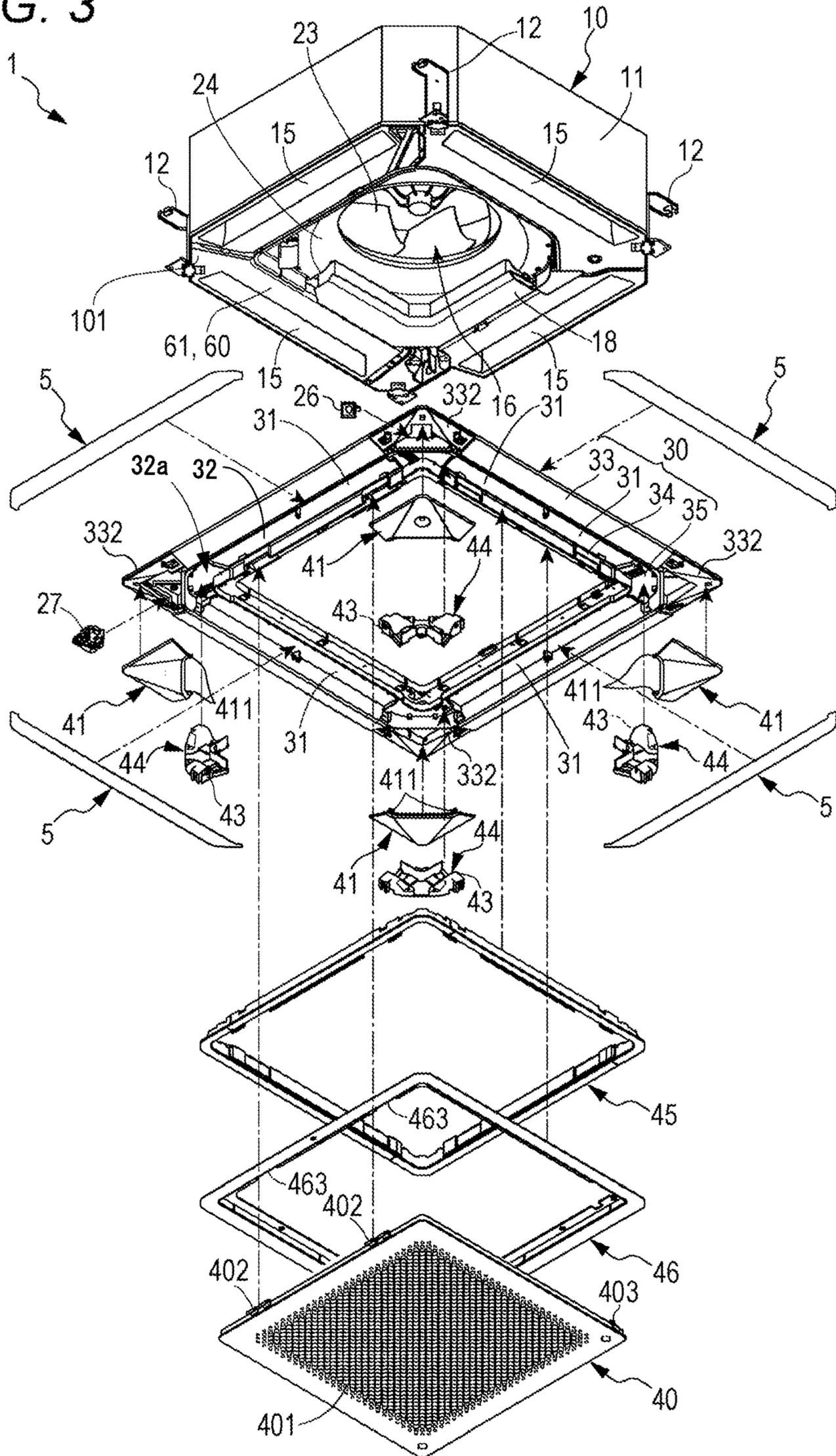


FIG. 5

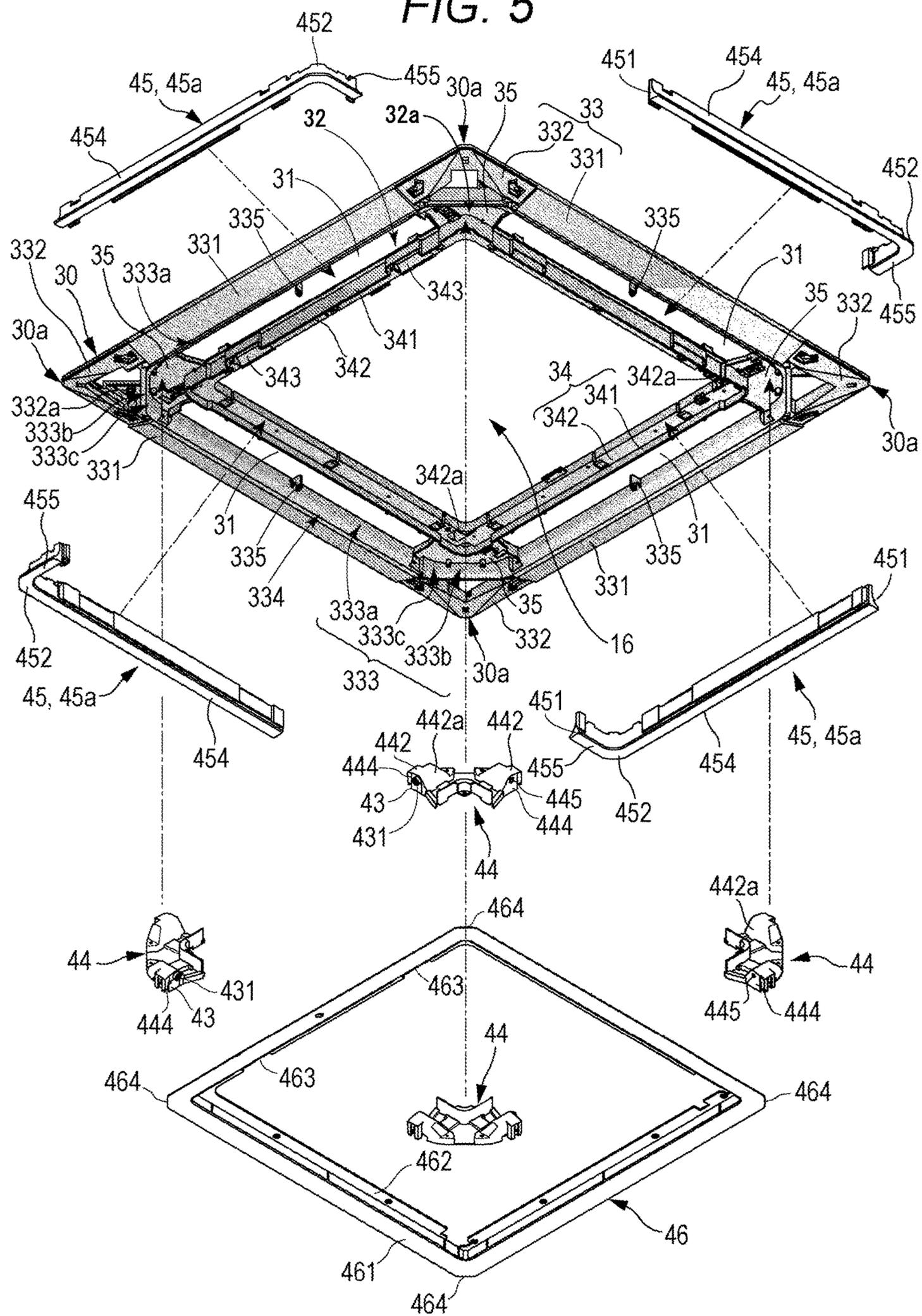


FIG. 6

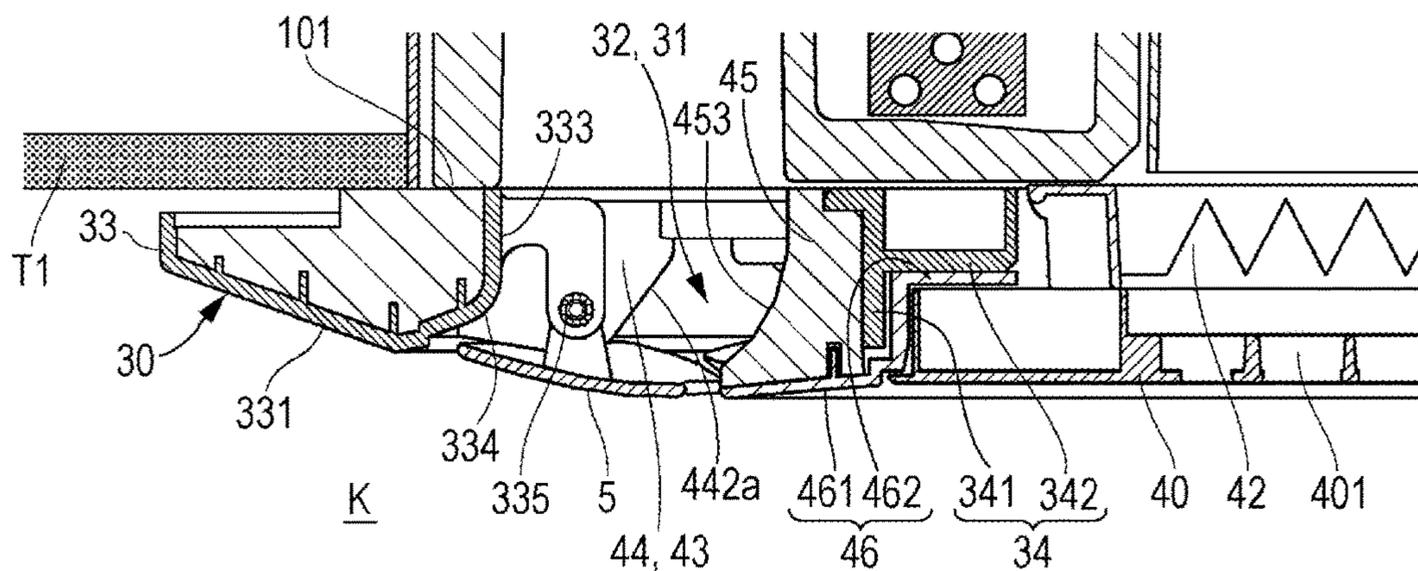


FIG. 7

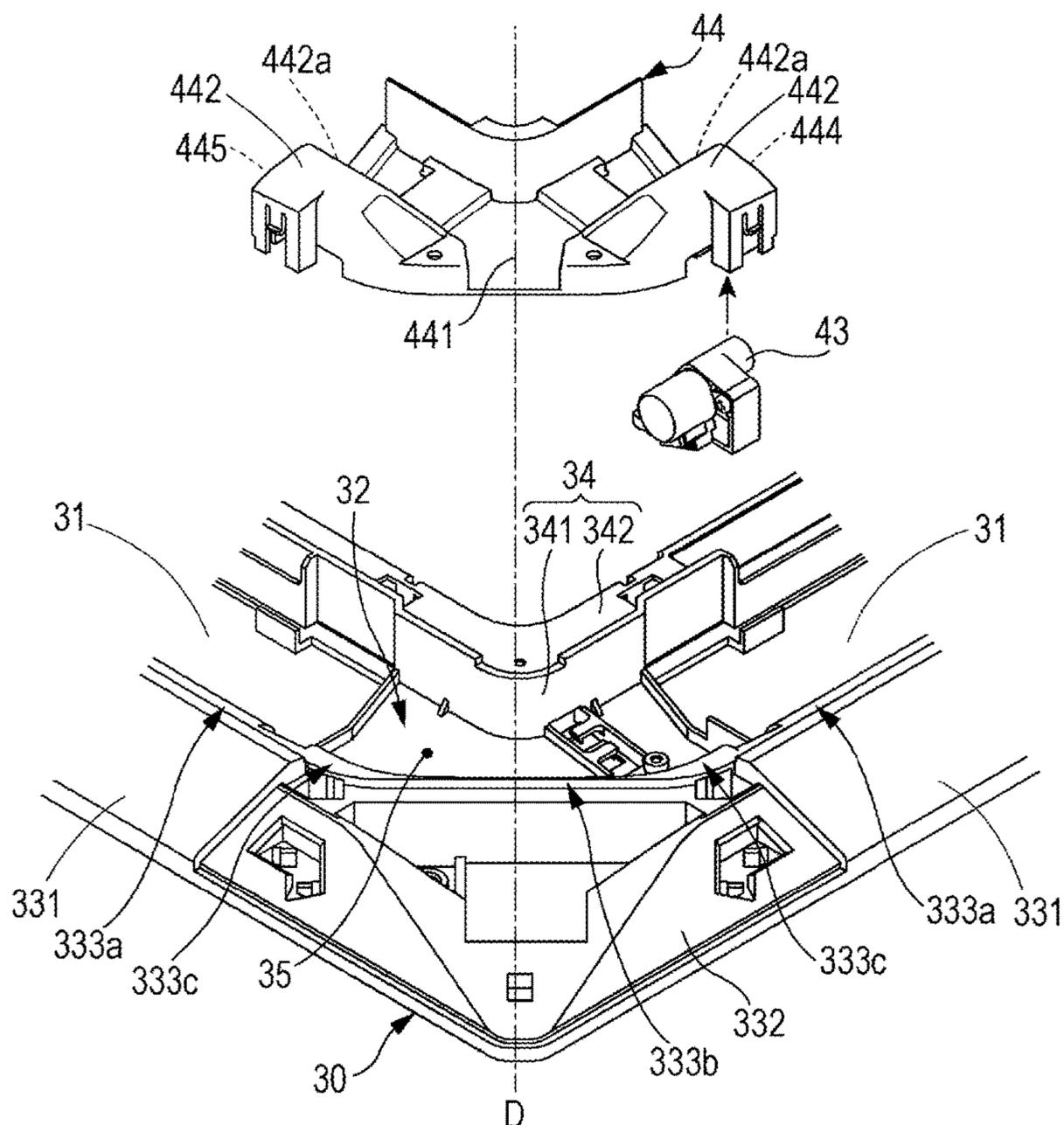


FIG. 8A

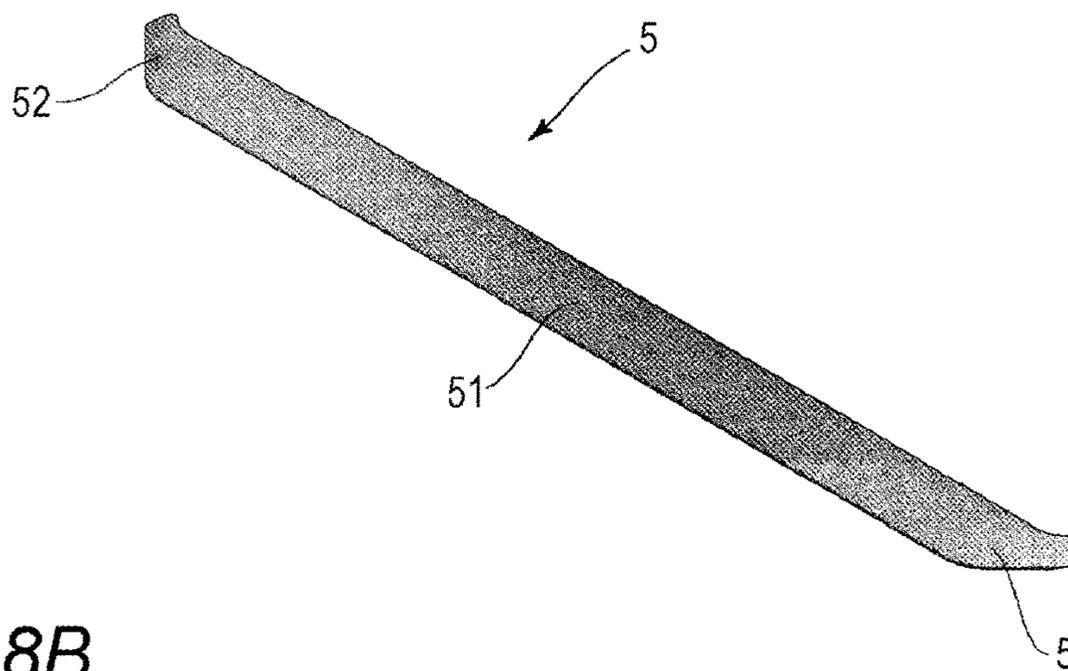


FIG. 8B

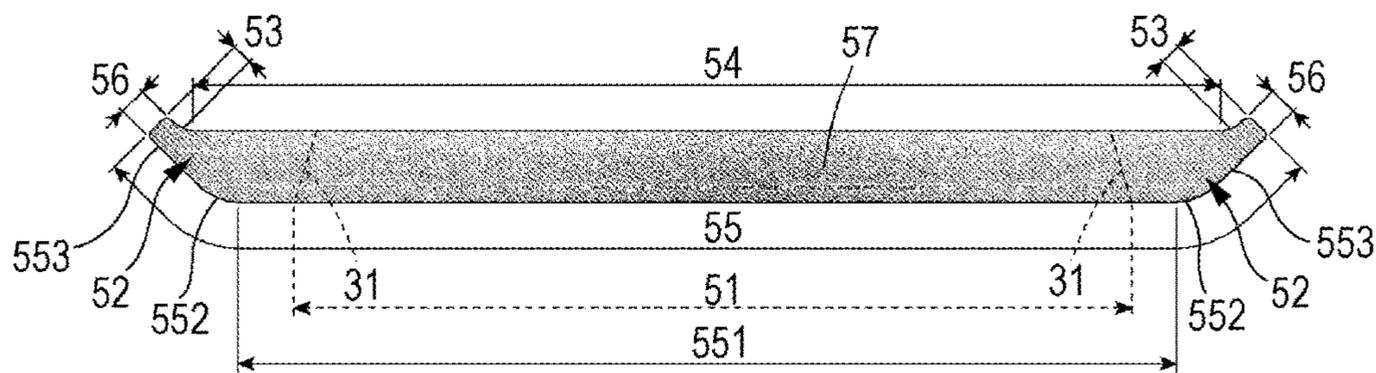


FIG. 8C

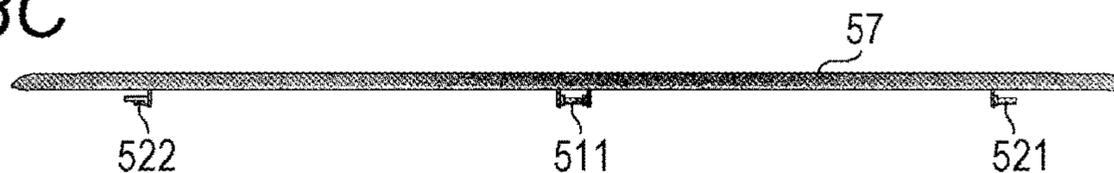


FIG. 8D

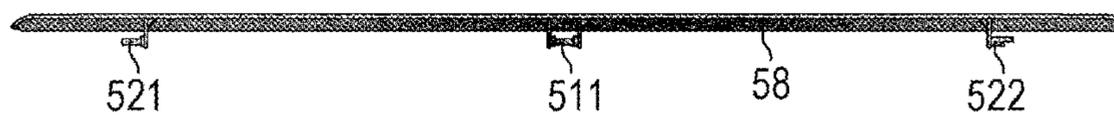


FIG. 8E

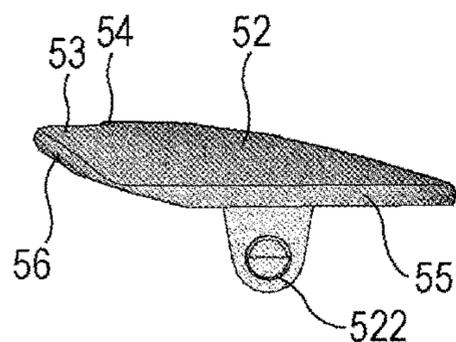


FIG. 8F

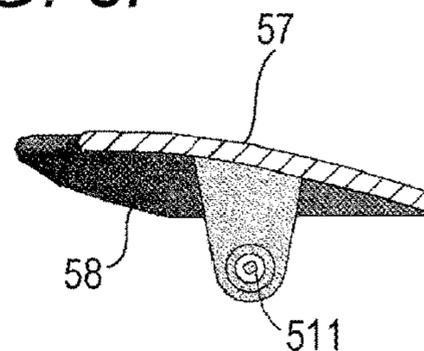


FIG. 9

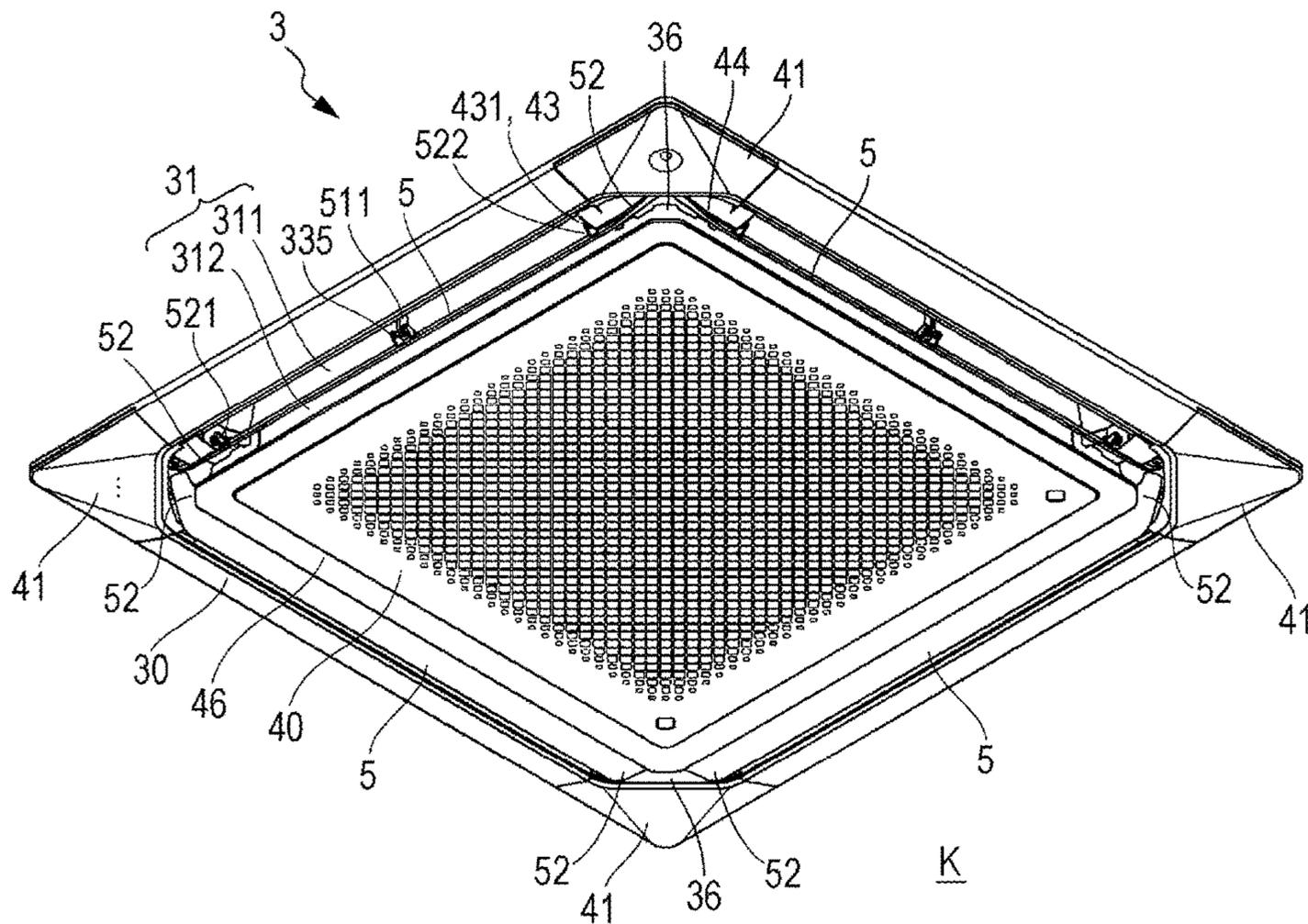
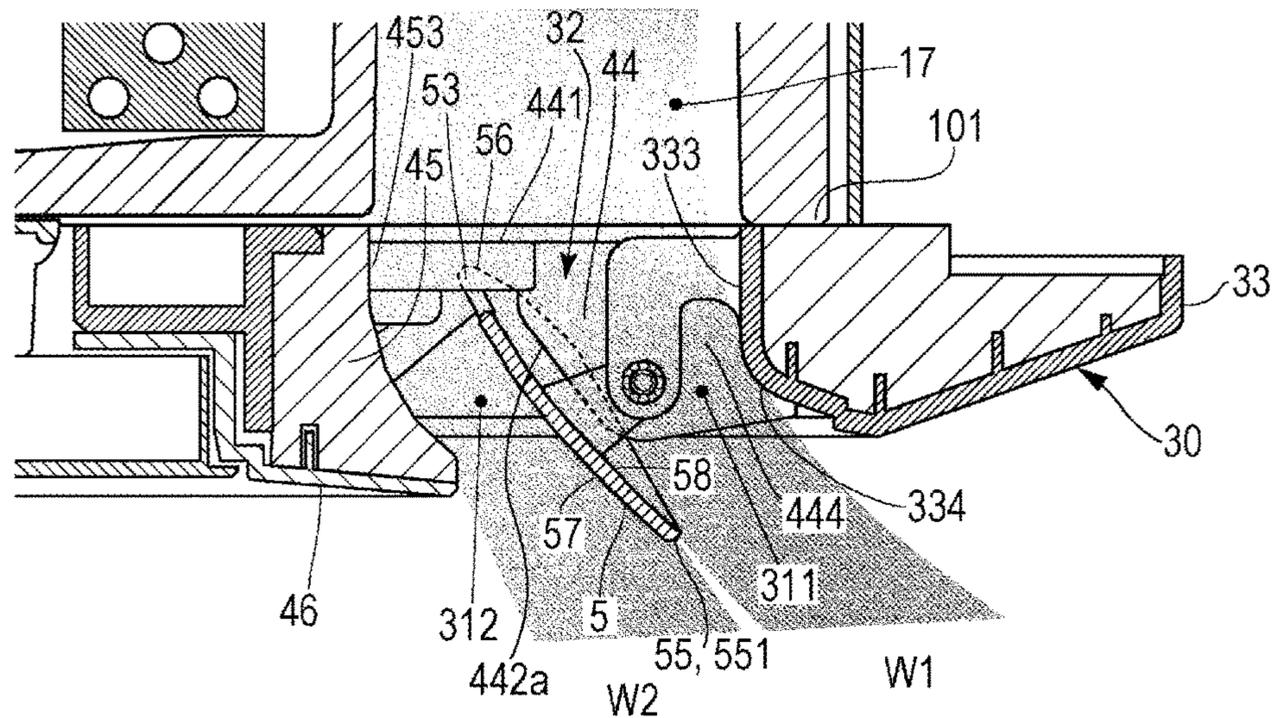


FIG. 10



K

FIG. 11

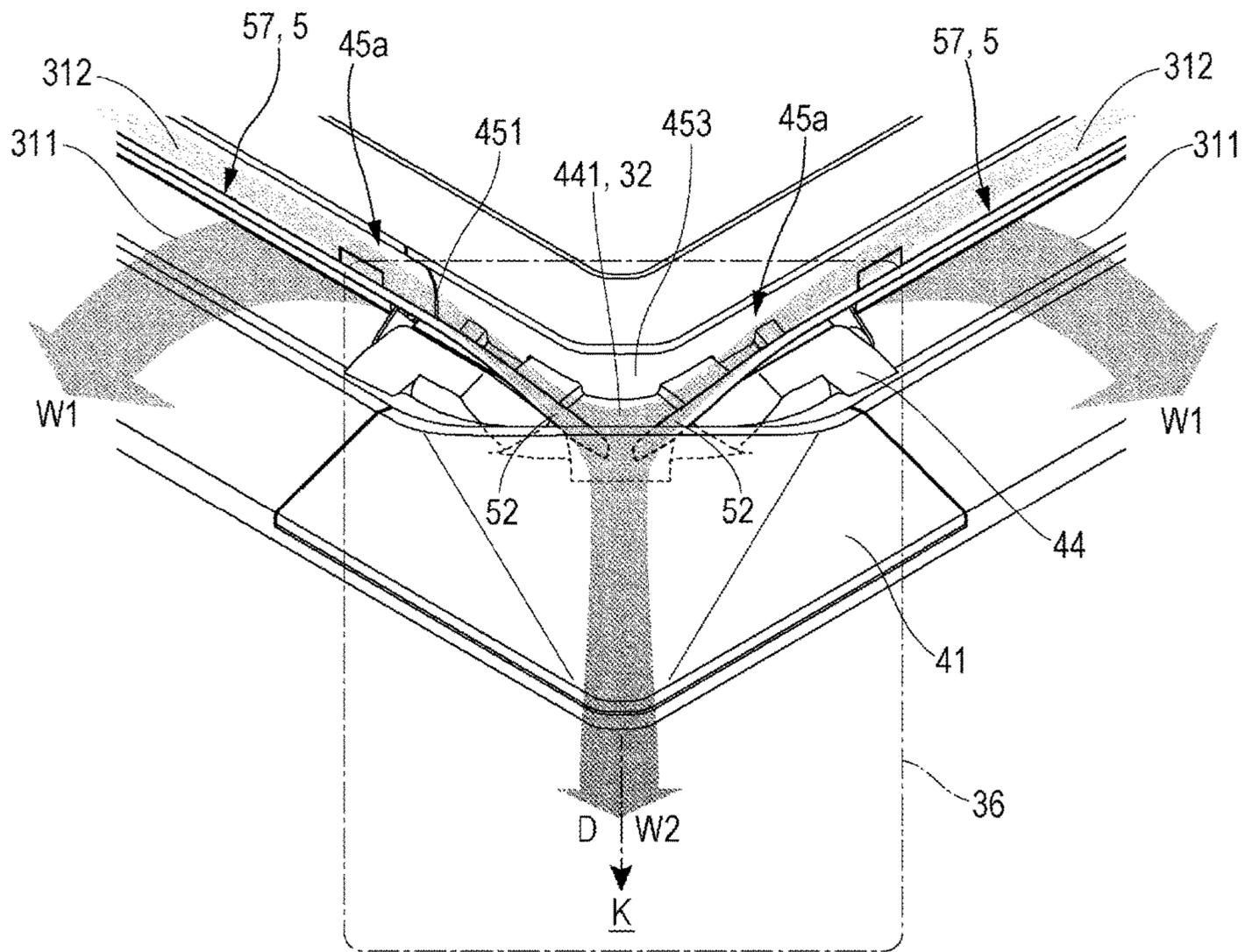
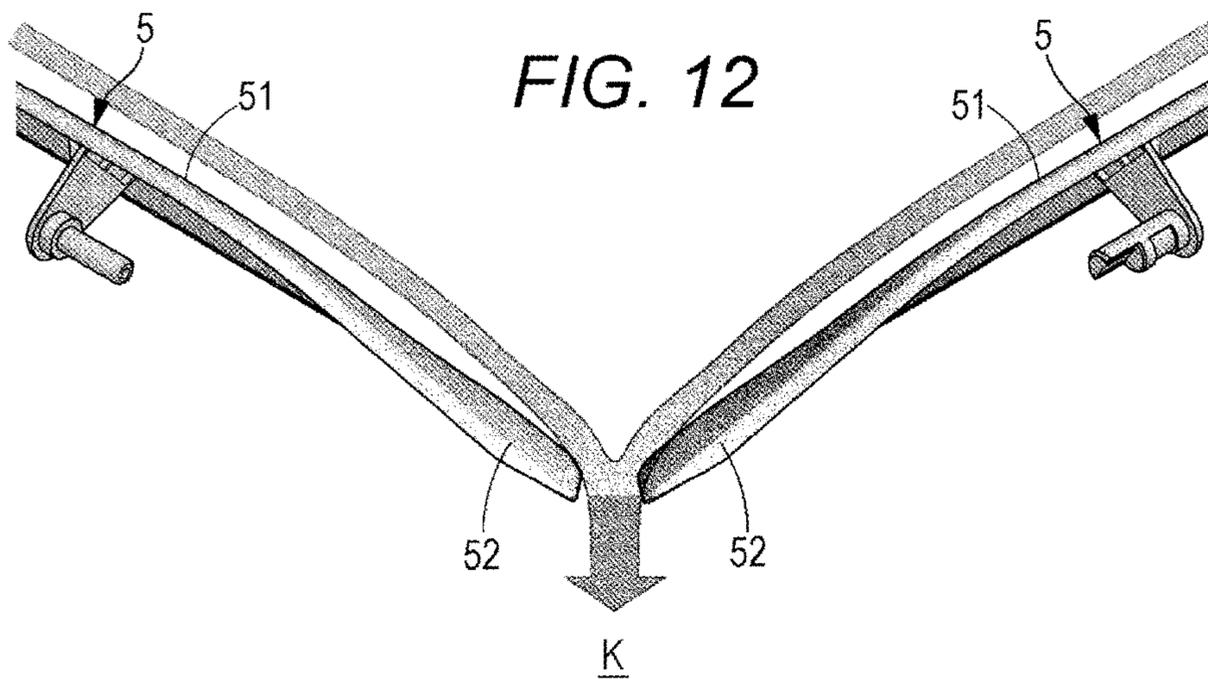


FIG. 12



CEILING-EMBEDDED AIR CONDITIONERCROSS-REFERENCE TO RELATED
APPLICATION

This application claims priority from Japanese Patent Application Nos. 2014-201523 and 2014-201524 filed with the Japan Patent Office on Sep. 30, 2014, the entire contents of which are hereby incorporated by reference.

BACKGROUND

1. Technical Field

One embodiment of the present disclosure relates to a ceiling-embedded air conditioner in which a housing is embedded in a ceiling.

2. Description of the Related Art

The ceiling-embedded air conditioner has a box-shaped housing including a heat exchanger and a blowing fan (turbo fan) and embedded in a ceiling. A suction grill in a decorative panel at the lower part of the housing sucks air in. The heat exchanger performs heat exchange between the sucked air and a refrigerant. The heat-exchanged air is adjusted in wind direction by wind direction plates and delivered from outlets into a room. This type of air conditioners is used in relatively large rooms in offices or stores.

A typical ceiling-embedded air conditioner has a suction grill at the center of an almost square decorative panel and outlets around the suction grill along the respective sides of the square decorative panel. The air conditioner also has wind direction plates suited to the shape of the outlets to cover the outlets. Motors for driving the wind direction plates are attached to the back surface of the decorative panel (refer to JP-A-2008-64396). In this structure, however, the blown air is supplied in the directions of the four sides of the ceiling-embedded air conditioner but is unlikely to be supplied in the directions of the four corners of the same.

Another typical ceiling-embedded air conditioner has a blowoff path around almost the entire circumference of a drain pan in the housing. The air conditioner is provided with a decorative panel, outlets, and auxiliary outlets. The outlets and the auxiliary outlets are disposed in an almost octagon shape. This allows the air to be blown in almost all directions (refer to Japanese Patent No. 4052264).

SUMMARY

A ceiling-embedded air conditioner includes: a box-shaped housing that is embedded in a ceiling of an air-conditioned room and has a blowing fan and a heat exchanger; a square decorative panel that is attached to a lower surface of the housing and covers the ceiling; main body outlets that are provided along respective four sides of a bottom surface of the housing and blow heat-exchanged air; outlets that are provided in the decorative panel so as to correspond to the main body outlets; corner blowoff units that are provided in the decorative panel so as to correspond to coupling portions for coupling the outlets; a blowoff path that is circumferentially provided in the decorative panel so as to correspond to the outlets and the corner blowoff units; and wind direction plates that are rotatably provided along the respective sides of the decorative panel so as to cover or open the blowoff path and are longer than a long side of the outlets.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an external view of a ceiling-embedded air conditioner in the shutdown state;

FIG. 2 is a cross-sectional view of the ceiling-embedded air conditioner, and the right side indicates the operating state and the left side indicates the shutdown state;

FIG. 3 is an exploded view of the ceiling-embedded air conditioner;

FIG. 4 is a front view of the ceiling-embedded air conditioner in the shutdown state;

FIG. 5 is an exploded view of a decorative panel in the ceiling-embedded air conditioner;

FIG. 6 is an enlarged view of FIG. 2 in the shutdown state;

FIG. 7 is an illustrative view of the decorative panel, a motor, and a motor cover in the ceiling-embedded air conditioner;

FIG. 8A is a perspective view of a wind direction plate in the ceiling-embedded air conditioner, FIG. 8B is a plane view of the wind direction plate, FIG. 8C is a front view of the wind direction plate, FIG. 8D is a rear view of the wind direction plate, FIG. 8E is an enlarged side view of the wind direction plate, and FIG. 8F is an enlarged cross-sectional view of the wind direction plate;

FIG. 9 is an external view of the ceiling-embedded air conditioner in the operating state;

FIG. 10 is an enlarged view of FIG. 2 in the operating state;

FIG. 11 is an illustrative view of a corner blowoff unit of the ceiling-embedded air conditioner; and

FIG. 12 is an illustrative view of the rotating wind direction plates in the ceiling-embedded air conditioner.

DESCRIPTION OF THE EMBODIMENTS

In the following detailed description, for purpose of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

According to the technique described in Japanese Patent No. 4052264, a large number of outlets are provided to complicate the structure of the housing. In particular, the drain pan is opened at almost the entire circumference and is supported by a reinforcement rib. Accordingly, the drain pan is decreased in strength. The wind direction plates are also provided at the auxiliary outlets to increase the number of components.

The wind direction plates are provided at all of the outlets and the auxiliary outlets in an almost octagon shape. Accordingly, the motors are attached to the respective wind direction plates to bring about increase in the number of components. The outlets are adjacent to each other and it is thus difficult to assure the spaces for attachment of the motors.

One object of the present disclosure is to provide a ceiling-embedded air conditioner as described below. That is, the ceiling-embedded air conditioner blows air in all directions (or almost all directions) without auxiliary outlets. This reduces temperature variations in an air-conditioned room and allows efficient air conditioning in large rooms.

Another object of the present disclosure is to provide a ceiling-embedded air conditioner as described below. That is, the ceiling-embedded air conditioner is provided with a blowoff path for guiding the air blown from the outlets to the corners of the decorative panel, and wind direction plates. This allows the ceiling-embedded air conditioner to blow air in all directions (or almost all directions) without having to provide auxiliary outlets. The ceiling-embedded air condi-

tioner is further provided with motors for rotating the wind direction plates within the blowoff path. This ensures the spaces for attachment of the motors.

A ceiling-embedded air conditioner (the air conditioner) according to one embodiment of the present disclosure includes: a box-shaped housing that is embedded in a ceiling of an air-conditioned room and has a blowing fan and a heat exchanger; a square decorative panel that is attached to a lower surface of the housing and covers the ceiling; main body outlets that are provided along respective four sides of a bottom surface of the housing and blow heat-exchanged air; outlets that are provided in the decorative panel so as to correspond to the main body outlets; corner blowoff units that are provided in the decorative panel so as to correspond to coupling portions for coupling the outlets; a blowoff path that is circumferentially provided in the decorative panel so as to correspond to the outlets and the corner blowoff units; and wind direction plates that are rotatably provided along the respective sides of the decorative panel so as to cover or open the blowoff path and are longer than a long side of the outlets.

In the air conditioner, the wind direction plates may have wind direction portions and auxiliary wind direction portions, the wind direction portions being opposed to the outlets and the auxiliary wind direction portions being provided at the ends of the wind direction portions and opposed to the coupling portions. The corner blowoff units may include: bottom paths that are provided in the blowoff path at positions corresponding to the coupling portions; and the auxiliary wind direction portions of the wind direction plates.

In the air conditioner, the wind direction plates may be configured such that, when the wind direction plates open the blowoff path, end portions of the auxiliary wind direction portions come under the bottom paths.

In the thus configured ceiling-embedded air conditioner according to one embodiment of the present disclosure, the wind direction plates are rotatable and movable within the blowoff path. In this case, the air blown from the outlets is guided to the corners (corner blowoff units) of the blowoff path through the space between the wind direction plates (auxiliary wind direction portions) and the blowoff path. The foregoing air and the air from the adjacent wind direction plates join together at the corner blowoff units.

The joining air is blown toward vacant spaces. Specifically, the joining air is blown from the tips of the adjacent wind direction plates (auxiliary wind direction portions) to the outside of the decorative panel. Accordingly, the ceiling-embedded air conditioner can blow air in all directions (or almost all directions) without having to provide auxiliary outlets. Therefore, the ceiling-embedded air conditioner allows efficient air conditioning in large rooms.

In the air conditioner, the blowoff path may include concaves continuously provided around the outlets and the coupling portions. The wind direction plates may be rotatably attached within the concaves (blowoff path) to cover or open the blowoff path. In this case, when the air conditioner is shut down (that is, the wind direction plates cover the blowoff path), the wind direction plates are flush or almost flush with the surface of the decorative panel. This improves design of the air conditioner.

In the air conditioner, the motors may be fixed to the blowoff path integrally with the motor covers.

Each of the motor covers may have a shape symmetric with respect to diagonal lines of the decorative panel, and include two motor storage portions at both sides of the diagonal lines that store the two motors for driving the two

wind direction plates corresponding to the two outlets coupled via the coupling portion. The motor storage portions may be inclined to be higher at the outlet side and lower at the inside of the blowoff path and the diagonal line side of the decorative panel. Bottom paths included in the corner blowoff units may be formed between the motor storage portions in the motor cover.

Furthermore, in the air conditioner, when the wind direction plates are rotated by the motors to open the blowoff path, the outlets may be divided by the wind direction plates into main blowoff portions and auxiliary blowoff portions and the motor storage portions of the motor covers may form wall surfaces at the main blowoff portion side.

In the thus configured air conditioner, the motors for rotating the wind direction plates are fixed in the blowoff path integrally with the motor covers for storing the motors. This allows air blowing in almost all directions and ensures the spaces for attachment of the motors. Further, the motors (and the motor covers) can be attached or detached through the surface of the decorative panel. This eliminates the need to remove the decorative panel from the housing at the time of maintenance of the motors, for example. This results in improvement of workability.

The motor covers may be symmetrical with respect to the diagonal lines of the decorative panel and include the motor storage portions at both sides of the diagonal lines. In this case, the bottom paths may be formed between the motor storage portions in the motor covers. Accordingly, the air is guided by the wind direction plates together at the bottom paths. The joining air is blown outward along extensions of the diagonal lines of the decorative panel.

An embodiment of the present disclosure will be described below in detail. However, the technique in the present disclosure is not limited to the foregoing embodiment.

<Ceiling-embedded Air Conditioner>

A ceiling-embedded air conditioner **1** (hereinafter, referred to as air conditioner **1**) according to the embodiment includes a box-shaped housing **10** embedded in a ceiling surface **T** of an air-conditioned room **K** and a square decorative panel **3** attached to a lower surface **101** of the housing **10**. The housing **10** is set in the ceiling by being hung on a plurality of hanging bolts not illustrated embedded in the back wall surface of the ceiling with the use of a plurality of attachment brackets **12** included in side plates **11** of the housing **10**. The decorative panel **3** is attached to the housing **10** by screwing attachment portions **332** described later to the attachment brackets **12** from the air-conditioned room **K** side. The decorative panel **3** covers the lower surface **101** of the housing **10** and the ceiling surface **T** in the air-conditioned room **K** around the lower surface **101**.

<Housing>

The case of the housing **10** includes a top plate **13** made from a metal plate and the side plates **11** extended downward from the outer periphery of the top plate **13**. Heat insulating members **14** are provided on the inner peripheral surfaces of the top plate **13** and the side plates **11** as illustrated in FIG. **2**. A fan motor **21** is screwed into the inside of center of the top plate **13**. A shaft **22** extended downward from the fan motor **21** supports pivotally a hub **23a** of a blowing fan **23**. The blowing fan **23** is a so-called turbo fan including the hub **23a**, a shroud **23b**, and a plurality of blades **23c**. The blowing fan **23** is arranged together with the fan motor **21** at almost the center of inside of the housing **10**.

As illustrated in FIGS. **2** and **3**, a drain pan **60** covers the lower part of the housing **10**. The drain pan **60** includes a heat insulating member **61** and a drain pan plate **62**

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described later. The drain pan 60 has an opening at the center that constitutes a suction opening 16. A bell mouth 24 is disposed in the suction opening 16 to couple the suction opening 16 and the blowing fan 23. An electrical equipment box 18 is disposed in the bell mouth 24 at the suction opening 16 side. The electrical equipment box 18 is L-shaped so as not to interfere with air W passing through the suction opening 16. The electrical equipment box 18 stores electrical component controlling the air conditioner 1.

The blowing fan 23 rotatably driven by the fan motor 21 sucks the room air W from the suction opening 16 into the housing 10. The air W sucked into the housing 10 is guided to the blowing fan 23 along the bell mouth 24 and then is blown toward the outside of the blowing fan 23.

A heat exchanger 25 is disposed around the blowing fan 23 to surround the blowing fan 23. The heat exchanger 25 is vertically sandwiched between the heat insulating members 14 and the drain pan 60. A resin drain pan plate 62 is provided on the surface of the drain pan 60 opposed to and receiving the lower part of the heat exchanger 25. The resin drain pan plate 62 is molded integrally with a foamed-resin heat insulating member 61 to receive drain water generated by the heat exchanger 25. The drain water is discharged to the outside of the room through a drain pump and a drain pipe coupled to the drain pump not illustrated.

The heat exchanger 25 is coupled to a reversible refrigeration cycle circuit (not illustrated) capable of cooling operation and heating operation. During the cooling operation, the heat exchanger 25 serves as an evaporator to cool the air W guided by the blowing fan 23. Meanwhile, during the heating operation, the heat exchanger 25 serves as a condenser to heat the air W guided by the blowing fan 23.

A blowing path 17 is formed by the space between the heat exchanger 25 and the heat insulating members 14 around the side plates 11 and four main body outlets 15 provided in the drain pan 60 along the respective four sides of the housing 10. The blowing path 17 guides the air W blown from the blowing fan 23 to outlets 31 of the decorative panel 3 described later. The outlets 31 are provided in the decorative panel 3 so as to correspond to the main body outlets 15. The air W heat-exchanged with a refrigerant by the heat exchanger 25 passes through the blowing path 17 and the main body outlets 15 and is blown from the outlets 31 into the air-conditioned room K.

The air conditioner 1 can blow air in all directions (or almost all directions) with a blowoff path 32 and corner blowoff units 36 described later, without having to provide auxiliary outlets unlike in the typical air conditioners. Accordingly, the drain pan 60 does not need openings for auxiliary outlets. This maintains the strength of the drain pan 60.

<Decorative Panel>

As described above, the decorative panel 3 is attached to the lower surface 101 of the housing 10. The decorative panel 3 is a square frame-shaped plate body as illustrated in FIG. 4, for example. The decorative panel 3 covers the lower surface 101 of the housing 10. Further, when the air conditioner 1 is attached to the ceiling surface T1, the decorative panel 3 covers the ceiling surface T1 around the lower surface 101 of the housing 10. The decorative panel 3 and another square body described later may include corners chambered by a straight line with an arc. As illustrated in FIGS. 3 and 4, the decorative panel 3 covers the ceiling surface T1. The decorative panel 3 has a decorative panel main body 30 with outlets 31, a suction grill 40, corner panels 41, four wind direction plates 5, motors 43, four motor covers 44, a panel heat insulating member 45, and a

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suction grill frame 46. The suction grill 40 is detachably attached to the center of the decorative panel main body 30. The corner panels 41 cover corners 30a of the decorative panel main body 30. The four wind direction plates 5 are attached to the outlets 31 of the decorative panel main body 30. The motors 43 drive the respective four wind direction plates 5. The four motor covers 44 fix the motors 43 to the decorative panel main body 30 and serve also as motor fixtures. The panel heat insulating member 45 forms the inner walls of the outlets 31. The suction grill frame 46 receives the suction grill 40 and serves also as a fixture for fixing the panel heat insulating member 45 to the decorative panel main body 30.

<Decorative Panel Main Body>

As illustrated in FIG. 5, the decorative panel main body 30 includes an outer frame portion 33, an inner frame portion 34, and coupling portions 35. The outer frame portion 33 is a square frame body, for example. The inner frame portion 34 stores the suction grill 40. The inner frame portion 34 is located closer to the center of the decorative panel main body 30 than the outer frame portion 33 is. The coupling portions 35 couple the outer frame portion 33 and the inner frame portion 34 in one plane at the corners 30a of the decorative panel main body 30 at the housing 10 side. The openings among the outer frame portion 33, the inner frame portion 34, and the coupling portions 35 constitute the outlets 31 corresponding to the main body outlets 15. That is, the coupling portions 35 couple the adjacent outlets 31.

Concaves 32a are formed around the outlets 31. Each of the concaves 32a is surrounded by the outer frame portion 33 and the inner frame portion 34. The coupling portions 35 partially constitute the bottom surfaces of the concaves 32a. The concaves 32a are continuously coupled to form the blowoff path 32. The blowoff path 32 guides the air blown from auxiliary blowoff portions 312 described later to the corners of the decorative panel. The blowoff path 32 is circumferentially provided a square shape, for example) in the decorative panel 3 so as to correspond to the outlets 31 and the corner blowoff units 36 described later (coupling portions 35). For example, the blowoff path 32 is provided along almost the entire circumference of the suction grill 40 described later. That is, the blowoff path 32 includes the concaves 32a continuously provided around the outlets 31 and the coupling portions 35.

<Outer Frame Portion>

The outer frame portion 33 has decorative surfaces 331 at portions corresponding to the four sides of the square decorative panel main body 30 as illustrated in FIGS. 5 and 6. The decorative surfaces 331 are inclined so as to be higher at the outlet 31 side and lower at the ceiling surface T1 side. Attachment portions 332 are provided at the four corners 30a coupling the decorative surfaces 331. The decorative panel 3 can be fixed to the housing 10 by screwing the attachment brackets 12 of the decorative panel 3 into screw holes 332a of the attachment portions 332. A human detection sensor 26 and an indicator LED 27 illustrated in FIG. 4 are attached to any one of the four attachment portions 332.

As illustrated in FIGS. 5 and 7, portions of edge surfaces 333 of the outer frame portion 33 facing the blowoff path 32 and contacting the outlets 31 include linearly-formed first straight portions 333a. Portions of the edge surfaces 333 coupled to the coupling portions 35 include second straight portions 333b and arc parts 333c. The second straight portions 333b are inclined 45 degrees relative to the first straight portions 333a. The arc parts 333c couple the first straight portions 333a and the second straight portions 333b in a gentle arc shape.

As illustrated in FIGS. 5 and 6, the decorative surfaces 331 and the attachment portions 332 are coupled to the edge surfaces 333 by arc-shaped curved surfaces 334. Bearings 335 are provided in the middles of the edges surfaces 333. The bearings 335 protrude toward the outlets 31 to support pivotally the wind direction plates 5.

<Inner Frame Portion>

The inner frame portion 34 of the decorative panel main body 30 includes inner walls 341 and attachment bases 342 as illustrated in FIGS. 5 and 6. The inner walls 341 are erected at the blowoff path 32 side. The attachment bases 342 are provided on the entire inner circumference of the inner walls 341.

<Corner Panels>

As illustrated in FIG. 3, the corner panels 41 cover the respective four attachment portions 332 of the outer frame portion 33. The corner panels 41 are fixed to the decorative panel main body 30 by hooking locking claws 411 on the attachment portions 332 of the outer frame portion 33, and are flush with the decorative surfaces 331. The corner panels 41 also include locking claws (not illustrated) on the surfaces at the attachment portion 332 side.

In addition, the human detection sensor 26 and the indicator LED 27 attached to the attachment portions 332 protrude from the corner panels 41.

<Motor Covers>

As illustrated in FIGS. 5 and 7, the motors 43 rotating the respective four wind direction plates 5 are disposed in the blowoff path 32 under (above in FIG. 7) the coupling portions 35 of the decorative panel main body 30. The motors 43 are stored in the motor covers 44 fixed to the decorative panel main body 30 and serving also as motor fixtures. The motors 43 are integrated with the motor covers 44 and are fixed to the coupling portions 35 of the decorative panel main body 30.

This ensures the spaces for attachment of the motors 43. In addition, the motors 43 can be attached and detached through the surface of the decorative panel. Accordingly, the decorative panel 3 does not need to be removed from the housing 10 at the time of maintenance of the motors 43, for example. This results in improvement of workability.

The motor covers 44 abut on the edge surfaces 333 of the outer frame portion 33 and are symmetrical with respect to diagonal lines D of the decorative panel 3. Each of the motor covers 44 includes symmetrical motor storage portions 442 for storing the motors 43 at right and left sides.

That is, the motor covers 44 are symmetrical with respect to the diagonal lines D of the decorative panel 3 and include the two each motor storage portions 442 on the both sides of the diagonal lines D. The two motor storage portions 442 store the two motors 43 for driving the two wind direction plates 5 corresponding to the two outlets 31 coupled via the coupling portion 35. The bottom surfaces of the motor covers 44 are included in the corner blowoff units 36 described later (constituting bottom paths 441). The bottom paths 441 included in the corner blowoff units 36 described later may be formed between the motor storage portions 442 in the motor covers 44.

The motor storage portions 442 have the bottom paths 441. The bottom paths 441 are inclined so as to be higher at the outlet 31 side and lower at the inside of the blowoff path 32 and the diagonal line D sides of the decorative panel 3. The bottom paths 441 are disposed in parallel with the diagonal lines D of the decorative panel 3, for example, between the two symmetrical motor storage portions 442

and 442 in the motor covers 44. The bottom paths 441 are provided in correspondence with the coupling portions 35 of the blowoff path 32.

The motor storage portions 442 has a wall surface 444 at the outlet 31 side as illustrated in FIGS. 5 to 7. In addition, the motor storage portions 442 include inclined surfaces 442a on the side opposite to the outer frame portion 33. The inclined surfaces 442a have an inclination angle of about 60 degrees. The motor storage portions 442 for storing the motors 43 have a bearing 431 for the motor 43 on the one wall surface 444. The motor storage portions 442 have a bearing 445 for a shaft part 521 of the wind direction plate 5 described later on the other wall surface 444.

<Panel Heat Insulating Member>

The panel heat insulating member 45 is provided in the blowoff path 32 at the suction grill 40 side as illustrated in FIG. 3. The panel heat insulating member 45 has a curved surface 453 at the blowoff path 32 side as illustrated in FIG. 6. This allows the panel heat insulating member 45 (curved surface 453) to serve as a blowoff guide that guides the air W blown from the outlets 31 toward the air-conditioned room K.

The panel heat insulating member 45 is formed by combining four so-called L-shaped panel heat insulating member pieces 45a as illustrated in FIG. 5. In each of the panel heat insulating member pieces 45a, a long side part 454 and a short side part 455 are orthogonal to each other at a corner part 452. Abutment surfaces 451 of the adjacent panel heat insulating member pieces 45a are engaged with each other in the vicinities of the end portions of the outlets 31 as illustrated in FIG. 11. Since the panel heat insulating member pieces 45a are combined in the vicinities of the end portions of the outlets 31, a small misalignment at seams between the panel heat insulating member pieces 45a would have little influence on the blowoff air W. In addition, the seams between the panel heat insulating member pieces 45a are hidden behind the motor covers 44 and thus are less prominent.

The corner parts 452 of the panel heat insulating member 45 in abutment with the motor covers 44 also have curved surfaces 453 at the blowoff path 32 side. Accordingly, the panel heat insulating member 45 (curved surfaces 453) serves as a blowoff guide that guides auxiliary blowoff air W2 to the corner blowoff units 36 described later.

<Suction Grill Frame>

The panel heat insulating member 45 is sandwiched and held between the suction grill frame 46 and the inner walls 341 of the inner frame portion 34 of the decorative panel main body 30 as illustrated in FIGS. 5 and 6. The suction grill frame 46 includes a decorative surface 461 and a receiving part 462. The decorative surface 461 surrounds the suction grill 40 in a frame shape and is flush with the suction grill 40. The receiving part 462 is formed stepwise at the inner side of the decorative surface 461 to receive the suction grill 40. The receiving part 462 is screwed and fixed to the attachment bases 342 of the inner frame portion 34 of the decorative panel main body 30. Accordingly, the panel heat insulating member 45 is sandwiched between the decorative panel main body 30 and the suction grill frame 46. Since the panel heat insulating member 45 is sandwiched and fixed between the suction grill frame 46 and the decorative panel main body 30 as described above, the air conditioner 1 can be simplified in structure and easy to assemble. That is, the air conditioner 1 is improved in ease of assembly without the need for providing heat insulators at the outlets. This suppresses component costs.

The suction grill frame 46 is a square in shape, for example. The suction grill frame 46 includes tapered surfaces 464 at the corners at the blowoff path 32 side along the wind direction plates 5 described later.

<Suction Grill>

As illustrated in FIGS. 1 to 4, the square suction grill 40 is detachably attached to the inside of the suction grill frame 46. The suction grill 40 includes a plurality of dotted suction holes 401 for taking the air into the suction opening 16. A dedusting filter 42 is detachably held on the rear surface (upper surface in FIG. 2) of the suction grill 40.

As illustrated in FIG. 3, the suction grill 40 has rotation shafts 402 at two points of one side of peripheral edges. The suction grill 40 also has fastening brackets 403 on the rear surface. The decorative panel main body 30 has bearings 343 on the inner walls 341 of the inner frame portion 34. The suction grill frame 46 has bearings 463 at the receiving part 462. The bearings 343 and 463 pivotally sandwich and support the rotation shafts 402 of the suction grill 40. The fastening brackets 403 are locked in fastening bracket holes 342a. The fastening bracket holes 342a are provided in the attachment bases 342 of the inner frame portion 34 of the decorative panel main body 30. This allows the suction grill 40 to rotate via the rotation shafts 402 relative to the bearings 343 and 463. Therefore, the suction grill 40 can be rotated and removed from the decorative panel main body 30, and the suction grill 40 can be rotated in reverse and attached to the decorative panel main body 30. The suction grill 40 is fixed to the decorative panel main body 30 by locking the fastening brackets 403 in the fastening bracket holes 342a.

<Blowoff Path>

The components of the decorative panel 3 are combined to form the blowoff path 32 as described above. The outer walls of the blowoff path 32 include the edge surfaces 333 and the curved surfaces 334 of the outer frame portion 33 of the decorative panel main body 30. The inner walls of the blowoff path 32 include the panel heat insulating member 45. The panel heat insulating member 45 is fixed to the decorative panel main body 30 so as to be sandwiched between the inner walls 341 of the inner frame portion 34 of the decorative panel main body 30 and the suction grill frame 46. The bottom surface of the blowoff path 32 includes the outlets 31 and the coupling portions 35 (motor covers 44).

<Wind Direction Plates>

As illustrated in FIGS. 1 and 4, the wind direction plates 5 are provided to cover almost the entire blowoff path 32 provided at the decorative panel 3 on almost the entire circumference of the suction 40. The wind direction plates 5 are rotatably provided along the respective sides of the decorative panel 3 so as to cover or open the blowoff path 32. The wind direction plates 5 are longer than the long side of the outlet 31. The four wind direction plates 5 are the same shape. The adjacent wind direction plates 5 have gaps therebetween at positions corresponding to the diagonal lines D of the square decorative panel 3.

As illustrated in FIGS. 2 and 6, the decorative panel 3 has the suction grill 40 and the suction grill frame 46 becoming higher toward the air-conditioned room K. The decorative panel 3 has a gently inclined portion from the blowoff path 32 side of the suction grill frame 46 to the decorative surfaces 331 of the outer frame portion 33 of the decorative panel main body 30. According to the inclination, the wind direction plates 5 are formed to be higher at the suction grill frame 46 side and lower at the edge surface 333 side of the outer frame portion 33.

As described above, in the air conditioner 1, the blowoff path 32 includes the concaves 32a continuously provided around the outlets 31 and the coupling portions 35. The wind direction plates 5 are rotatably attached into the concaves 32a (blowoff path 32) to cover or open the blowoff path 32 via shaft parts 511 described later. Therefore, when the air conditioner 1 is stopped (that is, the wind direction plates 5 cover the blowoff path 32), the wind direction plates 5 are flush or almost flush with the surface of the decorative panel 3. Therefore, the air conditioner 1 is improved in design.

The wind direction plates 5 are longer than the long side of the outlet 31. As illustrated in FIGS. 4, 8A, and 8B, each of the wind direction plates 5 includes a wind direction portion 51, auxiliary wind direction portions 52, third side parts 53, a first side part 54, and a second side part 55. The wind direction portion 51 is opposed to the outlet 31. The auxiliary wind direction portions 52 are positioned at the ends of the wind direction portions 51 and are opposed to the coupling portions 35 of the decorative panel 3 (the positions (sections) of the blowoff path 32 corresponding to the coupling portions 35, that is, the motor covers 44). The first side part 54 is a peripheral edge of the wind direction plate 5 at the suction grill 40 side. The second side part 55 is a peripheral edge of the wind direction plate 5 at the outer frame portion 33 side (outer side) and is opposed to the first side part 54. The second side part 55 includes a straight portion 551 corresponding to the outlets 31 and inclined portions 553. The inclined portion 553 is inclined from the both ends of the straight portion 551 toward the ends of the first side part 54.

The third side parts 53 are positioned at the ends of the first side part 54 of the wind direction plate 5 and are parallel or almost parallel to the inclined portions 553 of the second side part 55. The wind direction plate 5 further has fourth side parts 56. The fourth side parts 56 are erected, at the adjacent wind direction plate 5 side, vertically relative to the inclined portions 553 from the one each end of the inclined portions 553 and are coupled to the third side parts 53.

In the following description, the face of the wind direction plate 5 appearing on the decorative panel 3 side in the shutdown state will be designated as front face 57 as illustrated in FIG. 8B, and the face opposite to the front face 57 of the wind direction plate 5 will be designated as back face 58 as illustrated in FIG. 8F.

As illustrated in FIGS. 4 and 8B, the wind direction portion 51 has the first side part 54 and the second side part 55 that are lines in parallel or almost parallel with each other so as to correspond to the outlet 31. As illustrated in FIG. 8F, the wind direction portion 51 includes a gentle outward curve in the front face 57.

As illustrated in FIG. 8B, the first side part 54 is a line that is continuous from the wind direction portion 51 to the auxiliary wind direction portions 52. The third side parts 53 are provided at the ends of the first side part 54 and are parallel or almost parallel to the inclined portions 553 of the second side part 55. The fourth side parts 56 couples the both ends of the second side part 55 and the both ends of the third side parts 53 vertically or almost vertically relative to the second side part 55.

The first side part 54 and the third side parts 53 of the wind direction plate 5 described above are shaped in correspondence with the suction grill frame 46 illustrated in FIG. 4. The straight portion 551 of the second side part 55 is shaped in correspondence with the first straight portion 333a of the edge surface 333 of the outer frame portion 33 in the decorative panel main body 30 illustrated in FIG. 7. The inclined portions 553 of the second side part 55 are shaped

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in correspondence with the second straight portion **333b** of the edge surfaces **333** of the outer frame portion **33**. The second side part **55** further has second arc parts **552**. The second arc parts **552** are positioned between the straight portion **551** and the inclined portions **553** and are shaped in correspondence with the arc part **333c** of the edge surface **333** of the outer frame portion **33**.

The coupling portions between the first side part **54** or the third side parts **53** and the second side part **55** at the ends of the fourth side parts **56** are formed in a round shape to avoid contact with the coupling portion of the adjacent wind direction plate **5** in the rotating state.

Referring to the front view of FIG. **8B**, the auxiliary wind direction portions **52** appear to have the tips narrower than the wind direction portion **51**. As illustrated in the side view of FIG. **8E**, the first side part **54** and the second side parts **55** are almost the same in height. When the wind direction plate **5** covers the blowoff path **32**, the front face **57** of the auxiliary wind direction portions **52** has an angle closer to the vertical direction than the front face **57** of the wind direction portion **51**. Meanwhile, when the wind direction plate **5** opens the blowoff path **32** (at the maximum, for example) the front face **57** of the auxiliary wind direction portions **52** has an angle closer to the horizontal direction than the front face **57** of the wind direction portion **51**.

Each of the wind direction plates **5** has a shaft part **511** on the back face **58** of the wind direction portion **51** as illustrated in FIGS. **8C** and **8D**. The shaft part **511** is pivotally supported by the bearing **335**. The bearings **335** protrude from the outer frame portion **33** of the decorative panel main body **30** toward the outlets **31** and support pivotally the wind direction plates **5**. Shaft parts **521** and **522** are provided on the back face **58** of the auxiliary wind direction portion **52**. The shaft parts **521** are pivotally supported by the bearings **445** of the motor covers **44**. The shaft parts **522** are pivotally supported by the motor bearings **431** of the motor covers **44**.

<Shutdown State>

In the shutdown state of the air conditioner **1**, as illustrated in FIGS. **1** and **4**, the four adjacent wind direction plates **5** cover almost the entire blowoff path **32** (concaves **32a**) surrounding the suction grill **40**. Accordingly, the outlets **31** and the wind direction plates **5** are visually recognized as forming a line (narrow surface) parallel or almost parallel to the decorative panel **3** and the suction grill **40**. This produces uniformity in design of the air conditioner **1**. Thus, the design of the air conditioner **1** is improved.

<Operating State>

When the air conditioner **1** starts operation, the motors **43** rotate the shaft parts **522** of the wind direction plates **5** pivotally supported by the motor bearings **431** as illustrated in FIGS. **9** and **10**. Accordingly, the shaft parts **511** and **521** are also rotated. As a result, the wind direction plates **5** are rotated toward the blowoff path **32** at the first side part **54** side. The wind direction plates **5** can be rotated about 60 degrees at the maximum.

When the wind direction plates **5** are rotated, the first side parts **54** at the suction grill **40** side move into the blowoff path **32**. The third side parts **53** and the fourth side parts **56** slide into the bottom paths **441** of the motor covers **44**. Only the straight portions **551** some parts of the inclined portions **553**, and the second arc parts **552** of the second side parts **55** of the wind direction plates **5** protrude from the decorative panel main body **30**. That is, when the wind direction plates **5** open the blowoff path **32**, the ends of the auxiliary wind direction portions **52** (third side parts **53** and fourth side parts **56**) slide into the bottom paths **441**. This prevents the

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ends of the wind direction plates **5** from appearing to project. As a result, the wind direction plates **5** are less prone to be prominent even in the operating state. Therefore, the air conditioner **1** can be made with a design excellent in appearance.

As illustrated in FIG. **10**, when the wind direction plates **5** are rotated by the motors **43** to open the blowoff path **32**, the spaces between the back faces **58** of the wind direction plates **5** and the inclined surfaces **442a** of the motor covers **44** become narrower and thus the wind is unlikely to pass through the spaces. Accordingly, each of the outlets **31** is divided by the wind direction plate **5** into a main blowoff portion **311** and an auxiliary blowoff portion **312**. The main blowoff portion **311** is surrounded by the back face **58** of the wind direction plate **5**, the wall surface **444** of the motor storage portion **442** of the motor cover **44**, the edge surface **333** of the outer frame portion **33**, and the curved surface **334**. The auxiliary blowoff portion **312** is positioned between the front face **57** of the wind direction plate **5** and the panel heat insulating member **45**. The auxiliary blowoff portion **312** is coupled to the blowoff path **32**.

The amount of air blown from the blowing fan **23** is larger at the hub **23a** side of the blowing fan **23** due to a higher wind speed as illustrated in FIG. **2**. Therefore, the amount of air flowing toward the heat insulating members **14** is larger the blowing path **17**. Accordingly, most of the air **W** passing through the outlets **31** is vigorously blown as air **W1** from the main blowoff portions **311** into the air-conditioned room **K**.

Meanwhile, the air blown from the auxiliary blowoff portions **312** is likely to spread due to a lower wind speed. Accordingly, part of the blown air **W2** is guided to the corners of the blowoff path **32** along the space between the front faces **57** of the wind direction plates **5** at the auxiliary wind direction portions **52** and the blowoff path **32** as illustrated in FIGS. **11** and **12**.

The bottom paths **441** of the motor covers **44** are positioned in the vicinities of the auxiliary wind direction portions **52** of the adjacent wind direction plates **5** and the corners of the blowoff paths **32**. The bottom paths **441** and the auxiliary wind direction portions **52** of the adjacent wind direction plates **5** are included in the corner blowoff units **36**. The corner blowoff units **36** are provided in the decorative panel **3** so as to correspond to the coupling portions **35** coupling the outlets **31**. In a case where the faces of the wind direction plates **5** appearing on the decorative panel **3** side when the wind direction plates **5** covering the blowoff paths **32** are designated as front faces, the front faces of the auxiliary wind direction portions **52** partially constitute the corner blowoff units **36**.

The air **W2**, which is guided by the auxiliary wind direction portions **52** of the wind direction plates **5** and reached the corners of the blowoff paths **32**, joins together with the air **W2**, which is guided from the adjacent wind direction plates **5**, at the bottom paths **441** of the motor covers **44**.

The joining air **W2** is blown toward vacant spaces. In this regard, the curved surfaces **453** of the panel heat insulating member **45** are positioned at the suction grill **40** side. Meanwhile, the third side parts **53** and the fourth side parts **56** at the tips of the auxiliary wind direction portions **52** of the wind direction plates **5** come under the bottom paths **441**. Accordingly, the openings from the bottom paths **441** are wider outward along the extensions of the diagonal lines **D**. This allows the joining air **W2** to be blown outward along the extensions of the diagonal lines **D**.

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When the wind direction plates **5** open the blowoff paths **32** (at the maximum, for example), the front faces **57** of the wind direction plates **5** at the auxiliary wind direction portions **52** have an angle closer to the horizontal direction than the front faces of the wind direction portions **51**. This allows the air **W2** to be blown toward a wide area from the front faces **57** of the wind direction plates **5** at the auxiliary wind direction portions **52**.

According to the foregoing configuration, even when the decorative panel **3** is not provided with auxiliary outlets, the air **W2** blown from the auxiliary blowoff portions **312** is guided to the corners of the blowoff path **32** along the space between the auxiliary wind direction portions **52** of the wind direction plates **5** and the blowoff path **32**. The bottom paths **441** are positioned in the vicinities of the auxiliary wind direction portions **52** of the adjacent wind direction plates **5** and the corners of the blowoff path **32**. The air **W2**, which is guided to the auxiliary wind direction portions **52** of the wind direction plates **5** and reached the corners of the blowoff path **32**, joins together with the air **W2**, which is guided from the adjacent wind direction plates **5**, at the bottom paths **441**.

The joining air **W2** is blown toward vacant spaces. That is, the joining air **W2** is blown from the tips of the auxiliary wind direction portions **52** of the adjacent wind direction plates **5** toward the outside of the decorative panel **3**. Accordingly, the air conditioner **1** can blow air in all directions (or almost all directions) without having to provide auxiliary outlets unlike in the typical air conditioners. Therefore, the air conditioner **1** is a ceiling-embedded air conditioner that allows efficient air-conditioning in large rooms.

The present disclosure relates to a ceiling-embedded air conditioner with a housing embedded in a ceiling, more specifically, to a structure of outlets and wind direction plates. Alternatively, the present disclosure relates to a ceiling-embedded air conditioner with a housing embedded in a ceiling, more specifically, to a structure of outlets.

When the components of the decorative panel **3** are assembled, the blowoff path **32** may include the outer walls having the edge surfaces **333** and the curved surfaces **334** of the outer frame portion **33** of the decorative panel main body **30**, the inner walls having the panel heat insulating member **45** which is sandwiched and fixed between the inner walls **341** of the inner frame portion **34** of the decorative panel main body **30** and the suction grill frame **46**, and the bottom surface having the outlets **31** and the motor covers **44**.

The first side parts **54** and the third side parts **53** of the wind direction plates **5** may be shaped in correspondence with the suction grill frame **46** illustrated in FIG. 4. The second side parts **55** may have the straight portions **551** aligned with the first straight portions **333a** of the edge surfaces **333** of the outer frame portion **33** of the decorative panel main body **30** illustrated in FIG. 7, and may have the inclined portions **553** aligned with the second straight portions **333b** of the edge surfaces **333** of the outer frame portion **33**. The second side parts **55** may include the second arc parts **552** aligned with the arc parts **333c** of the edge surfaces **333** of the outer frame portion **33** between the straight portions **551** and the inclined portions **553**.

In the front view of FIG. 8B, the tips of the auxiliary wind direction portions **52** appear to be narrower than the wind direction portion **51**. Alternatively, the heights of the first side part **54** and the second side part **55** may be parallel to each other as illustrated in the side view of FIG. 8E. The front face of the auxiliary wind direction portion **52** may

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have an angle closer to the vertical direction than the front face of the wind direction portion **51**.

When the air conditioner **1** is in the shutdown state, the blowoff path **32** (concaves **32a**) may surround the suction grill **40** and the four adjacent wind direction plates **5** may cover the entire blowoff path **32** surrounding the suction grill as illustrated in FIGS. 1 and 4.

The amount of air blown from the blowing fan **23** is large because the wind speed at the hub **23a** side of the blowing fan **23** is high as illustrated in FIG. 2. Accordingly, a large amount of air flows toward the heat insulating members **14** through the blowing path **17** and most of the air **W** passing through the outlets **31** is vigorously blown as the air **W1** from the main blowoff portions **311** into the air-conditioned room **K**.

The ceiling-embedded air conditioner according to this embodiment may be any one of the following first to ninth ceiling-embedded air conditioners.

The first ceiling-embedded air conditioner includes a box-shaped housing embedded in a ceiling of an air-conditioned room and a square decorative panel attached to the lower surface of the housing to cover the ceiling, the housing including a blowing fan and a heat exchanger that surrounds the blowing fan at the center and a drain pan at the lower side, the drain pan being provided with a suction opening that takes the air into the blowing fan and main body outlets that blow heat-exchanged air along the respective four sides of the box-shaped housing, and the decorative panel being provided with a suction grill in correspondence with the suction opening and elongated rectangular outlets in correspondence with the main body outlets. The decorative panel has concaves formed around the outlets and continuously coupled to form a blowoff path and has wind direction plates that are longer than the long side of the outlet and are provided along the respective sides of the decorative panel to cover the blowoff path. The wind direction plates have wind direction portions, which are opposed to the outlets, and auxiliary wind direction portions opposed to the blowoff path at the ends of the wind direction portions. The blowoff path includes bottom paths at the corners in parallel to the diagonal lines of the decorative panel. When the wind direction plates are rotated and the suction grill sides of the wind direction plates move into the blowoff path, the auxiliary wind direction portions of the wind direction plates and the bottom paths form corner blowoff units.

In the second ceiling-embedded air conditioner according to the first ceiling-embedded air conditioner, in a case where the faces of the wind direction plates appearing on the decorative panel side when the wind direction plates cover the blowoff path are designated as front faces, the front faces of the auxiliary wind direction portions partially constitute the corner blowoff units.

In the third ceiling-embedded air conditioner according to the first or second ceiling-embedded air conditioner, each of the wind direction plates includes: a long first side part that is arranged at the suction grill side; a second side part that is opposed to the first side part and includes a straight portion in correspondence with the outlet and inclined portions inclined from the both ends of the straight portion toward the ends of the first side part; third side parts that are parallel to the inclined portions of the second side part at the ends of the first side parts; and fourth side parts that are erected from the ends of the inclined portions in the direction vertical to the inclined portions and are coupled to the third side parts. When the wind direction plate is opened at the maximum, the third side parts and the fourth side parts come under the bottom surface of the blowoff path.

In the fourth ceiling-embedded air conditioner according to any of the first to third ceiling-embedded air conditioners, when the wind direction plates cover the blowoff path, the front faces of the auxiliary wind direction portions of the wind direction plates have an angle closer to the vertical direction than the front faces of the wind direction portions. When the wind direction plates are opened at the maximum, the front faces of the auxiliary wind direction portions of the wind direction plates have an angle closer to the horizontal direction than the front faces of the wind direction portions.

In the fifth ceiling-embedded air conditioner according to the first ceiling-embedded air conditioner, motors for rotating the wind direction plates and motor covers for storing the motors are attached in the blowoff path between the adjacent outlets. The bottom surfaces of the motor covers constitute the bottom paths.

In each of the first to fifth ceiling-embedded air conditioners, when the wind direction plates are rotated and the suction grill sides of the wind direction plates moves into the blowoff path, the air blown from the outlets is guided to the corners of the blowoff path along the space between the auxiliary wind direction portions of the wind direction plates and the blowoff path. The bottom paths are provided at the adjacent wind direction plates and the corners of the blowoff path. The air blown from the outlets joins together with the air, which is guided from the adjacent wind direction plates, at the bottom paths.

The joining air is blown toward vacant spaces. Accordingly, by blowing the air from the tips of the auxiliary wind direction portions of the adjacent wind direction plates to the outside of the decorative panel, the ceiling-embedded air conditioner allows air blowing in all directions without any auxiliary outlets and efficient air-conditioning in large rooms.

The sixth ceiling-embedded air conditioner includes a box-shaped housing embedded in a ceiling of an air-conditioned room and a square decorative panel attached to the lower surface of the housing to cover the ceiling, the housing including a blowing fan and a heat exchanger that surrounds the blowing fan at the center and a drain pan at the lower side, the drain pan being provided with a suction opening that takes the air into the blowing fan and main body outlets that blow heat-exchanged air along the respective four sides of the box-shaped housing, and the decorative panel being provided with a suction grill in correspondence with the suction opening and outlets in correspondence with the main body outlets. The decorative panel has concaves formed around the outlets and continuously coupled to form a blowoff path and has wind direction plates that are longer than the long side of the outlet and are provided along the respective sides of the decorative panel to cover the blowoff path. Motors for rotating the wind direction plates are fixed integrally with motor covers, for storing the motors, at the corners in the blowoff path.

In the seventh ceiling-embedded air conditioner according to the sixth ceiling-embedded air conditioner, the motor covers are symmetrical with respect to the diagonal lines of the decorative panel and include symmetrical motor storage portions for storing the motors on the both sides. Each of the motor storage portions is higher at the outlet side and lower at the inside of the blowoff path and the diagonal line sides of the decorative panel. The symmetrical motor storage portions have a bottom path therebetween.

In the eighth ceiling-embedded air conditioner according to the sixth or seventh ceiling-embedded air conditioner, when the wind direction plates are rotated by the motors, the outlets are divided into main blowoff portions and auxiliary

blowoff portions and the motor storage portions of the motor covers form wall surfaces at the main blowoff portion side.

In the ninth ceiling-embedded air conditioner according to any of the sixth to eighth ceiling-embedded air conditioners, when the wind direction plates are rotated by the motors, the wind direction plates, the spaces between the adjacent wind direction plates, and the bottom paths form corner blowoff units that guide the air in the auxiliary blowoff portions.

In each of the sixth to ninth ceiling-embedded air conditioners, the decorative panel has the blowoff path that is formed by the concaves continuously coupling the outlets and has the wind direction plates that are provided to cover the blowoff path along the respective sides of the decorative panel. Accordingly, the air conditioner allows air blowing in all directions without having to provide auxiliary outlets. The motors for rotating the wind direction plates are fixed integrally with the motor covers, for storing the motors, at the corners of the blowoff path to ensure the spaces for attachment of the motors in spite of an all-direction blowoff type. In addition, the motors can be attached and detached through the surface of the decorative panel to eliminate the need for removing the decorative panel from the housing at the time of maintenance of the motors, for example, thereby resulting in improvement of workability. Further, the motor covers are symmetrical with respect to the diagonal lines of the decorative panel and include the symmetrical motor storage portions for storing the motors at the both sides. The motor covers have bottom paths between the symmetrical motor storage portions, which allows the air guided to the wind direction plates to join together at the bottom paths and blow outward along extensions of the diagonal lines of the decorative panel. Accordingly, the motor covers form part of the corner blowoff units.

The foregoing detailed description has been presented for the purposes of illustration and description. Many modifications and variations are possible in light of the above teaching. It is not intended to be exhaustive or to limit the subject matter described herein to the precise form disclosed. Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims appended hereto.

What is claimed is:

1. A ceiling-embedded air conditioner comprising:
 - a box-shaped housing that is embedded in a ceiling of an air-conditioned room and has a blowing fan and a heat exchanger;
 - a square decorative panel that is attached to a lower surface of the housing and covers the ceiling;
 - a square suction grill at a center of the decorative panel;
 - main body outlets that are provided along respective four sides of a bottom surface of the housing and blow heat-exchanged air;
 - outlets that are provided in the decorative panel along respective four sides of the decorative panel so as to correspond to the main body outlets;
 - coupling portions that couple adjacent outlets at corners of the decorative panel;
 - a blowoff path that is provided around at least a portion of a circumference of the suction grill in the decorative panel so as to correspond to the outlets and the coupling portions; and
 - wind direction plates that are rotatably provided along the respective four sides of the decorative panel so as to

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cover or open the blowoff path and are longer than a long side of the outlets, the wind direction plates having gaps between adjacent wind direction plates; wherein the wind direction plates cover at least a portion of the blowoff path, each of the wind direction plates comprises a first side edge, a second side edge, and two third side parts, the second side edge is opposed to the first side edge, the first side edge being closer to the suction grill than the second side edge is, the second side edge comprises a straight portion corresponding to each of the outlets and inclined portions that are inclined from both ends of the straight portion toward adjacent wind direction plates, the two third side parts are positioned at ends of the first side edge, each of the two third side parts being inclined toward adjacent wind direction plates, the decorative panel comprises an outer frame portion and an inner frame portion, which constitute the blowoff path, and the outer frame portion comprises first straight portions and second straight portions, each of the first straight portions being parallel to the straight portion of the second side edge of the wind direction plates, each of the second straight portions being parallel to adjacent inclined portions of the wind direction plates.

2. The ceiling-embedded air conditioner according to claim 1, wherein the wind direction plates have wind direction portions and auxiliary wind direction portions, the wind direction portions being opposed to the outlets, and the auxiliary wind direction portions being provided at ends of the wind direction portions and opposed to the coupling portions, and the blowoff path comprises bottom paths at positions corresponding to the coupling portions; and the auxiliary wind direction portions of the wind direction plates are at positions corresponding to the coupling portions.

3. The ceiling-embedded air conditioner according to claim 2, wherein front faces of the auxiliary wind direction portions partially constitute one or more corner blowoff units.

4. The ceiling-embedded air conditioner according to claim 3, wherein the front faces of the auxiliary wind direction portions are inclined by comparison to front faces of the wind direction portions when the wind direction plates cover the blowoff path.

5. The ceiling-embedded air conditioner according to claims 2, wherein the wind direction plates are configured such that, when the wind direction plates open the blowoff path, end portions of the auxiliary wind direction portions slide into the bottom paths.

6. The ceiling-embedded air conditioner according to claim 1, further comprising: motors for rotating the wind direction plates and motor covers for storing the motors, the motors and the motor covers being provided in the blowoff path at positions corresponding to the coupling portions.

7. The ceiling-embedded air conditioner according to claim 6, wherein bottom surfaces of the motor covers are included in the corner blowoff units.

8. The ceiling-embedded air conditioner according to claim 1, wherein

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the blowoff path includes concaves provided around the outlets and the coupling portions.

9. The ceiling-embedded air conditioner according to claim 6, wherein the motors are fixed to the blowoff path integrally with the motor covers.

10. The ceiling-embedded air conditioner according to claim 9, wherein each of the motor covers has a shape symmetric with respect to one of a plurality of diagonal lines of the decorative panel, and includes two motor storage portions, one of the two motor storage portions being located at one side of the diagonal lines and the other one of the two motor storage portions being located at the other side of the diagonal lines, at least one of the two motor storage portions storing one of the motors for driving one of the wind direction plates corresponding to one of the outlets, the motor storage portions are inclined to be higher at a side of the motor storage portions closest to the outlets and lower at a side of the motor storage portions furthest from the outlets, and the blowoff path comprises bottom paths at positions corresponding to the coupling portions and between the motor storage portions in the motor covers.

11. The ceiling-embedded air conditioner according to claim 10, wherein when the wind direction plates are rotated by the motors to open the blowoff path, the outlets are divided by the wind direction plates into main blowoff portions and auxiliary blowoff portions, and the motor storage portions of the motor covers form wall surfaces at the side of the main blowoff portions.

12. The ceiling-embedded air conditioner according to claim 1, wherein the wind direction plates are provided to face the coupling portions and to cover an entirety of each of the outlets and an entirety of the blowoff path.

13. The ceiling-embedded air conditioner according to claim 1, wherein each of the wind direction plates further comprises two fourth side parts that are positioned vertically relative to the inclined portions of the second side edge, and each of the fourth side parts is parallel with one of a plurality of diagonal lines of the square suction grill.

14. The ceiling-embedded air conditioner according to claim 1, wherein each of the wind direction plates further comprises two fourth side parts that are positioned perpendicular to the inclined portions of the second side edge, and each of the fourth side parts is parallel with one of a plurality of diagonal lines of the square suction grill.

15. The ceiling-embedded air conditioner according to claim 1 further comprising: a panel heat insulating member that is attached to a lower surface of the decorative panel in the blowoff path, and is constituted by combining four L-shaped panel heat insulating member pieces, the panel heat insulating member comprising a curved surface facing the blowoff path and guiding air blown from the outlets towards corners of the decorative panel.

16. The ceiling-embedded air conditioner according to claim 1, wherein the first side edge consists of a single straight line, and the straight portion of the second side edge consists of a single straight line.

17. The ceiling-embedded air conditioner according to claim 1, wherein each of the second straight portions of the outer frame portion connects adjacent first straight portions of the outer frame portion.

18. The ceiling-embedded air conditioner according to claim 2, wherein the auxiliary wind direction portions are bent toward adjacent wind direction plates.

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